(Engl translation of JP)

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-022902
(43)Date of publication of application : 26.01.2001

(51)Int.Cl. G06K 17/00

(21)Application number : 11-195792
(22)Date of filing : 09.07.1999

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## (54) READER/WRITER FOR ID TAG

(57)Abstract:
PROBLEM TO BE SOLVED: To simplify a configuration that acquires tag information from an ID tagon the basis of a received signal from a plurality of receiving antennas.
SOLUTION: An MPU 29 of a controller 27 outputs a transmission signal for power to a transmitting antenna 25 of a selected antenna. An ID tag 47 transmits tag information by receiving and operating the received transmission signal for power. The MPU 29 amplifies the received signal received by the receiving antenna of the selected antenna with an amplifier circuit 32 and then reads the tag information by making the received signal into binary form in a detection circuit 34. Herethe MPU 29 sets an amplification factor of the amplifier circuit 32 according with the selected antenna and also sets a threshold in the circuit 34. Thusit is possible to appropriately perform amplification without being affected by noiseeven though receiving sensitivity or a received noise level is different in each antenna.

## CLAIMS

[Claim(s)]
[Claim 1]A reader writer for ID tags which is provided with the following and characterized by reading tag information in said ID tag where a widening rate of said receiving circuit is set up by said widening rate setting-out means.
Two or more receiving antennas which receive a signal from an ID tag.
A receiving circuit which widens an input signal which a receiving antenna selected among these receiving antennas received.
A widening rate decision means which asks for a widening rate of said receiving

circuit so that a signal level of an input signal from a receiving antenna selected in the state of the electric power supply to said ID tag may turn into the optimal receiving level.
A widening rate setting-out means to set up a widening rate of said receiving circuit become the widening rate which this widening rate decision means judged.

[Claim 2]A reader writer for ID tags which is provided with the following and characterized by reading tag information in said ID tag where reference level of said receiving circuit is set up by said reference level setting-out means.
Two or more receiving antennas which receive a signal from an ID tag.
A receiving circuit which carries out binarization by comparing with reference level an input signal which a receiving antenna selected among these receiving antennas received.
A receiving level judging means which asks for a receiving level of said receiving circuit in a non communication state with said ID tag.
A reference level setting-out means to ask for optimal reference level based on a receiving level for which this receiving level judging means asked.

[Claim 3]The reader writer for ID tags according to claim 2 provided with a reference level verifying means which checks reference level set up by said reference level setting-out means.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the reader writer for ID tags for reading the ID information from an ID tag.
[0002]
[Description of the Prior Art]Drawing 15 shows an example of this kind of antenna control device. In this drawing 15two or more antennassuch as the large-sized antenna 1the medium size antenna 2the small antenna 3and the flabellate antenna 4are installed in the shelf which is not illustratedand each antennas 1-4 are connected with the reader writer 5 for ID tags in the state where it was connected mutually. These antennas 1-4 contain a transmission antenna and a receiving antennaand are constitutedand the antenna with the selected reader writer 5 for ID tags operates.
[0003]The receiving circuits 6-9 corresponding to a receiving antenna are established in the reader writer 5 for ID tagsrespectivelyand MPU10The input signal from the ID tag located on the antenna 1-4 is received by switching each receiving circuits 6-9 in

order according to turning on and off of the switches 11a-11h.
[0004]In this casethe widening rate of each receiving circuits 6-9 is set up according to the characteristic of the receiving antennas 1-4. When "10" levels are required as a signal level of an input signal and the receiving level of the large-sized antenna 1 is "1" in the decoder 11specificallythe widening rate of the receiving circuit 6 for large-sized antenna 1 is set up 10 times. When the receiving level of the medium size antenna 2 is "2"the widening rate of the receiving circuit 7 for medium size antennas is set up 5 times. When the receiving level of the small antenna 3 is "5"the widening rate of the receiving circuit 8 for small antennas is set up twice. And when the receiving level of the flabellate antenna 4 is "3"the widening rate of the receiving circuit 9 for flabellate antennas is set up 3.3 times.
[0005]And MPU10 can acquire the tag information which was analyzed as tag information in the decoder 12 after binarization of the input signal was carried out in each receiving circuits 6-9made it Mr. ** and was analyzed.
[0006]On the other handdrawing 16 shows the example from which the above-mentioned receiving antenna differs in composition. In this drawing 16to the transmission antenna which is not illustratedthe antenna 13 has the 1st receiving antenna 14the 2nd receiving antenna 15and the 3rd receiving antenna 16and is constituted.
He is trying for MPU10 of the reader writer 5 for ID tags to acquire tag information based on the input signal from the receiving antennas 14-16 by connecting the antenna selected according to turning on and off of the switches 17a-17f with the corresponding receiving circuits 18-20.

[0007]
[Problem(s) to be Solved by the Invention]Howeverin each composition mentioned abovea receiving circuit increases and composition is complicatedso that the number of receiving antennas increases from the necessity of providing a receiving circuit corresponding to each receiving antennarespectively.
[0008]From the strength of the noise level from the ambient environment which each receiving antenna receives by the installation operating environment of an antenna and an ID tag differing. Readjusted the threshold of the signal level for every receiving circuit in the installation site of the systemor the installed environment of the customer needed to be changedand the work was very troublesomeand large-sized-izing of the reader writer for ID tags and a high cost were invited.
[0009]In the composition provided with two or more receiving circuits in order to receive the signal from two or more receiving antennas by one reader writer for tagsas especially mentioned above. The threshold for carrying out binarization of the input signal from a receiving antenna in a receiving circuit is unsuitable to the reader writer for ID tags of which a miniaturization and low cost are required [ in / adjustment is required respectively and / this point ] for every receiving circuit

according to the characteristic of each receiving antenna.
[0010]This invention was made in light of the above-mentioned circumstancesand the purpose is to provide the reader writer for ID tags which can simplify an entire configuration in the composition which acquires tag information from an ID tag based on the input signal from two or more receiving antennas.
[Means for Solving the Problem]According to the invention of claim 1a widening rate decision meansAsking for a widening rate of a receiving circuit so that a signal level of an input signal from a receiving antenna selected in the state of the electric power supply to an ID tag may turn into the optimal receiving levela widening rate setting-out means sets up a widening rate of a receiving circuit become the widening rate which a widening rate decision means judged.
[0011]And since tag information is read in an ID tag where a widening rate of a receiving circuit is set up by a widening rate setting-out meansEven though it changes a signal level of an input signal from a receiving antenna by switching a receiving antennaan input signal can be widened at always optimal widening rateand tag information can be certainly read in an ID tag.
[0012]According to the invention of claim 2since a receiving level of a receiving circuit in a non communication state with an ID tag is based on an environmental noiseit can ask for optimal reference level based on a receiving level for which a receiving level judging means asked.
[0013]And since tag information is read in an ID tag where reference level of a receiving circuit is set up by a reference level setting-out meanseven though it changes a receiving level of an environmental noisebinarization of the input signal can be carried out with always optimal reference leveland tag information can be certainly read in an ID tag.
[0014]According to the invention of claim 3since reference level which a reference level setting-out means set up by a reference level verifying means was checkedreference level can be set up certainly.
[0015]
[Embodiment of the Invention](A 1st embodiment) A 1st embodiment that applied this invention to the lending management system of the library is hereafter described with reference to drawing 1 thru/or drawing 12.
[0016]Drawing 2 shows the entire configuration roughly. In this drawing 2the shelf antennas 21-24 are arranged at the bookshelf-like storing caseand storage exhibition of a bookthe rental videoetc. is carried out on that shelf antenna 21-24. The ID tag is attached to such books and videotapesand the book and rental video which are kept by the shelf are managed with an ID tag.
[0017]In the state where it was connected mutuallythe above-mentioned shelf antennas 21-24 are connected with the controller (equivalent to the reader writer for ID tags) 27and each controller 27Tag information is acquired from the ID tag located on each shelf antenna 21-24 by controlling the shelf antennas 21-24 in order

according to the instructions from the host computer 28.
[0018]Heredrawing 3 shows the connecting relation of the controller 27 and each shelf antennas 21-24. In this drawing 3the fan antenna 24 etc. which suited the shape of the large-sized antenna 21the medium size antenna 22the small antenna 23and the showcase as a shelf antenna according to the size of a shelf are installed suitably.
[0019]These shelf antennas 21-24 contain the transmission antenna 25the receiving antenna 26 (refer to drawing 1)and a communication terminaland are constituted. In this caseit has become as [ operate / the predetermined shelf antenna ] by choosing a communication terminal according to the instructions from the controller 27. That isthe selected communication terminal transmits the signal for electric power to an ID tag from a transmission antenna according to the instructions from the controller 27and it transmits the tag signal from the ID tag received with the receiving antenna to the controller 27.
[0020]Drawing 1 shows the composition of the controller 27 roughly. In this drawing 1the controller 27 is constituted considering MPU29 as a subjectand transmits the signal for electric power to ID tag 47 through the transmission antenna 25 from the sending circuit 30.
[0021]MPU(equivalent to widening rate decision meanswidening rate setting-out meansreceiving level judging meansreference level setting-out meansand reference level verifying means) 29Tag information is acquired from an ID tag via the filter 31the widening circuit 32the rectification circuit 33the detector circuit 34 (the above is equivalent to a receiving circuit)and the decode circuit 35.
[0022]Herethe widening circuit 32 widens the input signal which passed the filter 31and is constituted by the instructions from MPU29 so that change of the widening rate to an input signal is possible.
[0023]The detector circuit 34 changes into a binarization signal the input signal which passed through the rectification circuit 33 based on a threshold (reference level)and is constituted by the instructions from MPU29 so that change of a threshold is possible.
[0024]Drawing 4 shows the electric constitution of the widening circuit 32. In this drawing 4the widening circuit 32 is constituted as a reversal widening circuit which made the operational amplifier 36 the subjectand inputs into the non-inversed input terminal of the operational amplifier 36 the input signal which passed the filter 31. Between the non-inversed input terminal of this operational amplifier 36and the output terminaltwo or more gain resistance 37-40 is connected in seriesand. Multiple connection of the switches 41-43 turned on and off by MPU29 is carried out to the gain resistance 38-40 of these gain resistanceandas for resistance ****** of the whole gain resistancethe widening rate of the widening circuit 32 is adjusted according to turning on and off of each switches 41-43. In this caseafter all the switches 41-43 have turned offthe widening rate of the widening circuit 32 becomes the lowestand this state is made into an initial state. The widening rate set up by one

of each switches 41-43 is controlled to become the optimal every antenna 21-24 so that it may mention later.
[0025]Drawing 5 shows the electric constitution of the detector circuit 34. In this drawing 5the detector circuit 34 changes into a binarization signal with a comparator the light-receiving signal which passed through the rectification circuit 33.
[0026]That isthe inversed input terminal of the operational amplifier 44 which makes the subject of a comparator is connected with the A/D input port of MPU29and MPU29 is changed by the A/D converter which does not illustrate the output voltage from the rectification circuit 33.
[0027]The D/A output port of MPU29 is connected with the series circuit of the resistance 45 and the resistance 46and MPU29 outputs prescribed voltage to the series circuit of the resistance 45 and the resistance 46 by the D/A converter which is not illustrated. The common node of the resistance 45 and the resistance 46 is connected with the non-inversed input terminal of the operational amplifier 44and the voltage is set up as a threshold of a comparator. It is because it is made to correspond when MPU29 reduces the voltage from a D/A output port with the partial pressure of the resistance 45 and 46since the threshold range of the operational amplifier 44 is smaller than the output voltage range from the D/A output port of MPU29 and this is set up.
[0028]The non-inversed input terminal of the operational amplifier 44 is connected with the A/D input port of MPU29and MPU29 inputs the threshold of the operational amplifier 44 by the A/D converter which is not illustrated. This is for checking whether the threshold is a target threshold by detecting the threshold the partial pressure was carried out by the resistance 45 and 46 of.
[0029]On the other handas shown in drawing 1ID tag 47 has a resonant circuit which consists of the antenna 48 and the capacitor 49it receives the signal for electric power transmitted from the transmission antenna 25and generates the sending signal of predetermined frequency based on the signal for electric powerand transmits. In this casewhen a question signal is included in the received signal for electric powerID tag 47 superimposes predetermined tag information on a sending signaland transmits to it.
[0030]Nextan operation of the above-mentioned composition is explained. Nowin the controller 27since the input signal from two or more antennas 21-24 is widened by the one widening circuit 32When the widening rate of the widening circuit 32 is fixedthe signal level of an input signal shifts from the optimal leveland it becomes impossible to analyze an input signal appropriately. Thenthe controller 27 was controlled so that an input signal served as the optimal level as follows.
[0031]Drawing 6 shows automatic setting operation of the widening rate of the widening circuit 32 in operation of MPU29. In this drawing 6MPU29 switches the widening circuit 32 to an initial state firstwhen reading tag information in ID tag 47 (S101). Therebyas shown in drawing 4the switches 41-43 serve as OFFand the

widening rate of the widening circuit 32 serves as the minimum.
[0032]ThenMPU29 chooses a predetermined shelf antenna from among the shelf antennas 21-24 (S102)and transmits the signal for electric power from the transmission antenna 25 (S103). Therebysince the signal for electric power is transmitted to ID tag 47 from the transmission antenna 25from ID tag 47the signal according to the frequency of the signal for electric power is transmitted. At this timetag information is not included in the sending signal from ID tag 47.
[0033]ThenMPU29 inputs the signal level of the input signal from ID tag 47 from an A/D input port (S104)and judges the widening rate of the widening circuit 32 based on the input level (S105). That isit judges that it is set to the ideal signal level outputted from the widening circuit 32 by the widening rate of the widening circuit 32. In this casesince the signal level of the input signal from ID tag 47 shows the characteristic which becomes small and is set to "1" with the large-sized antenna 21 so that the shape of a shelf antenna becomes largeIf the ideal signal level outputted from the widening circuit 32 is set to "10"it is necessary to set up the widening rate of the widening circuit 32 10 times.
[0034]ThereforeMPU29 adjusts the resistance of the whole gain resistance of the widening circuit 32 by switching each switches 41-43 so that the widening rate of the widening circuit 32 may be abbreviated 10 time (S106).
[0035]Similarlyeach antennas 21-24 are chosen in orderand where the optimal widening rate according to the selected antenna is set as the widening circuit 32tag information is read in ID tag 47 through each antennas 21-24. That isaccording to the signal level of an input signal being "2" when reading tag information in ID tag 47 through the medium size antenna 22as shown in drawing 7a widening rate is set as "5"According to the signal level of an input signal being "5" when reading tag information in ID tag 47 through the small antenna 23a widening rate is set as "2"When reading tag information in ID tag 47 through the fan antenna 24according to the signal level of an input signal being "3"a widening rate is set as "3.3."
[0036]By the wayas shown in drawing 8when the threshold in the detector circuit 34 is larger enough than a noise level and smaller enough than the high-level fluctuation range of a signal levelIn the detector circuit 34it receives that binarization of the input signal can be carried outwithout being influenced by a noiseAs shown in drawing 9the threshold in the detector circuit 34 cannot be smaller than a noise levelor as shown in drawing 10when a threshold is larger than a signal levelbinarization of the input signal cannot be carried out correctly.
[0037]In this casesince the characteristics of each antennas 21-24 differ and the noise levels received also to the same environmental noise differthe noise levels widened in the widening circuit 32 differ for every antenna. For this reasonwhen binarization was carried out with the threshold which fixed the input signal in the detector circuit 34it enabled it to change an input signal into a binarization signal correctly as follows from it becoming impossible to change an input signal into a

binarization signal correctly according to fault which was mentioned above.
[0038]Drawing 11 is a flow chart which shows threshold setting operation of MPU29. In this drawing 11MPU29 carries out prescribed frequency execution of the operation of inputting the received signal level in (S201) and a non communication state with ID tag 47 from an A/D portwhen the shelf antennas 21-24 are chosen (S202S203).
[0039]At this timethe receiving antenna 26 of the selected antenna has received the environmental noiseand since the received signal level for which it asked as mentioned above shows the size of the environmental noiseMPU29 calculates a threshold based on a noise level (S204).
[0040]And MPU29 outputs prescribed voltage from a D/A portas a predetermined threshold is outputted to the detector circuit 34 by the partial pressure by the resistance 45 and 46 (S205).
[0041]HereMPU29 inputs the threshold of the detector circuit 34 from an A/D port (S206)it checks whether the inputted threshold has exceeded the target threshold (S207)and when not having exceededonly a predetermined level increases the output voltage from a D/A output port (S208).
[0042]And when the threshold of the detector circuit 34 comes to exceed a predetermined level(S207:YES) and its output state are maintained. The suitable threshold according to the size of the environmental noise to the shelf antennas 21-24 is set up as a result of the above operation.
[0043]That isas shown in drawing 12when the noise level of the large-sized antenna 21 is "5"it is controlled so that the threshold of the detector circuit 34 is set to "6." When the noise level of the medium size antenna 22 is "4"the threshold of the detector circuit 34 is controlled to be set to "5." When the noise level of the small antenna 23 is "3"the threshold of the detector circuit 34 is controlled to be set to "4." And when the noise level of the fan antenna 24 is "2"the threshold of the detector circuit 34 is controlled to be set to "3."
[0044]Nowwhen the widening rate of the widening circuit 32 and the threshold of the detector circuit 34 are set up corresponding to the shelf antennas 21-24 chosen as were mentioned aboveMPU29 transmitswhere a question signal is superimposed on the signal for electric power from the transmission antenna 25 of the selected antenna. Therebysince ID tag 47 transmits tag informationafter even the optimal level widens the input signal from ID tag 47 in the widening circuit 32MPU29 can read the tag information from ID tag 47 certainly by carrying out binarization with the optimal threshold in the detector circuit 34.
[0045]Thereforethe host computer 28 can manage the book or video currently kept based on the tag information from ID tag 47 located on the shelf antenna 21-24 through each controller 27.
[0046]When communicating with ID tag 47 through the predetermined shelf antennas 21-24 according to such an embodimentSince tag information was read in ID tag 47 where gain resistance of the widening circuit 30 is switched so that it might become

the optimal widening rate corresponding to the shelf antennas 21-24 as a widening rate of the widening circuit 30Irrespective of the characteristic of the shelf antennas 21-24an input signal can be widened so that it may be set to the optimal level.
[0047]Since it was made to carry out binarization of the input signal in the state where it set up exceed the threshold in the detector circuit 34 rather than a noise levelbinarization of the input signal can be carried out without being influenced by an environmental noise. Thereforetag information can be certainly read in an ID tag irrespective of a difference of the characteristic of the shelf antennas 21-24or the size of an environmental noise.
[0048](A 2nd embodiment) Drawing 13 shows a 2nd embodiment of this invention. This 2nd embodiment was applied to the composition which equipped one antenna with two or more receiving antennas.
[0049]Namelyin drawing 13 in which an entire configuration is shown roughlythe antenna 51 combines the 1st antenna section 52the 2nd antenna section 53and the 3rd antenna section 54Corresponding to the transmission antenna which is not illustratedthe three receiving antennas 52a are formed in the 1st antenna section 52Corresponding to the transmission antenna which is not illustratedthe two receiving antennas 53a are formed in the 2nd antenna section 53and the one receiving antenna 54a is formed in the 3rd antenna section 54 corresponding to the transmission antenna which is not illustrated. And the switches 55-57 which consist of a relay or a photo thyristor corresponding to each antenna sections 52-54 are formedand when the switches 55-57 are turned on and off by the controller 27the predetermined antenna sections 52-54 are chosenand it operates.
[0050]In this casesince each antenna sections 52-54 differ also in the noise level which the characteristics differand suitable widening rates differ for every receiving antenna with selected one of the switches 55-57and is receivedIn the widening circuit 30 of the controller 27the optimal widening rate is set up automatically corresponding to the receiving antenna 26.
[0051]The threshold in the detector circuit 34 is set automatically as the intermediate level of a noise level and a signal level. That isin addition to a noise levelalso take into consideration the signal level of the input signal from ID tag 47set up the threshold of the detector circuit 34and as a threshold in the detector circuit 34When a noise level is "2" and a signal level is "5" in the 1st antenna section 52a threshold is set as "4." When a noise level is "2" and a signal level is "4" in the 2nd antenna section 53a threshold is set as "3." And when a noise level is "2" and a signal level is "3" in the 3rd antenna section 54a threshold is set as "2.5."
[0052]Since the threshold in the detector circuit 34 was set as the intermediate level of a noise level and a signal level according to such an embodimenttag information can be certainly read in ID tag 43without receiving the influence of change of an environmental noise or a received signal level.
[0053](A 3rd embodiment) Drawing 14 shows a 3rd embodiment of this invention. This

3rd embodiment is having applied the large-sized antenna which has the same characteristic to the composition mutually connected like a 1st embodiment.
[0054]Namelyas an entire configuration is shown in drawing 14 shown roughlyeven if it is the composition of connecting two or more large-sized antennas 21 of identical propertyand inputting the input signal from ID tag 47Depending on the arrangement state of existence of a noise sourceexistence of metalor ID tag 47. In the composition using two or more large-sized antennas 21 of identical property since the noise level or the received signal level from ID tag 47 which the receiving antenna 26 receives is differentIt is made to set up in the middle of a noise level and a received signal level as a threshold in the detector circuit 34 like a 2nd embodiment.
[0055]Since the characteristic of the large-sized antenna 21 is the samein usuala noise level In this case2If the noise source of what is "7" is in the large-sized antenna 21 which exists in the neighborhoodsince the noise level is higher than "5" and usuala received signal level sets up "6" as a threshold. If metal is in the large-sized antenna which exists in the neighborhoodsince the received signal level is lower than "4" and usual3is set up as a threshold. If it is in a normal large-sized antenna5is set up as a threshold. And if it is in the large-sized antenna 21 which ID tag 47 inclines and existssince the received signal level is lower than "4" and usual3is set up as a threshold.
[0056]Since the threshold in a detector circuit was set as the intermediate level of a noise level and a received signal level in the composition using two or more antennas of identical property according to such an embodimentThe tag information from ID tag 47 can be certainly read like a 2nd embodimentwithout receiving the influence of change of an environmental noise and a received signal level.
[0057]This invention is not limited to each above-mentioned embodimentand can be transformed or extended as follows. It may be made to perform either one of the automatic regulation of a widening rate in a widening circuitand an automatic regulation of the threshold of the comparator in a detector circuit. It may be made to perform an automatic regulation of the threshold of the comparator in an automatic regulation and detector circuit of the widening rate in a widening circuit periodically.

## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The block diagram showing the whole composition for a 1st embodiment of this invention
[Drawing 2]The figure showing the whole connecting relation
[Drawing 3]The figure showing the connecting relation of a controller and each shelf antenna
[Drawing 4]The electric diagram showing the composition of a widening circuit

[Drawing 5]The electric diagram showing the composition of a detector circuit
[Drawing 6]The flow chart which shows operation of the widening circuit by MPU
[Drawing 7]The figure showing the relation between the signal level for every antennaand a widening rate
[Drawing 8]The figure showing the state where the received signal level has exceeded the noise level
[Drawing 9]The figure showing the state where the noise has exceeded the threshold
[Drawing 10]The figure showing the state where the input signal is less than the threshold
[Drawing 11]The flow chart which shows operation of MPU
[Drawing 12]The figure showing the relation between the noise level for every antennaand a threshold
[Drawing 13]The drawing 3 equivalent figure showing a 2nd embodiment of this invention
[Drawing 14]The drawing 3 equivalent figure showing a 3rd embodiment of this invention
[Drawing 15]The drawing 3 equivalent figure showing a conventional example
[Drawing 16]The drawing 3 equivalent figure showing other conventional examples
[Description of Notations]
21-24 a shelf antenna and 25 a transmission antenna and 26 A receiving antenna27 -- a controller (reader writer for ID tags)and 29 -- MPU (a widening rate decision means.) A widening rate setting-out meansa receiving level judging meansa reference level setting-out meansa reference level verifying means32 -- a widening circuit (receiving circuit) and 34 -- as for a switch and 44an operational amplifierand 37-40 are [ resistance and 47 ] ID tags an operational amplifierand 45 and 46 gain resistanceand 41-43 a detector circuit (receiving circuit) and 36.